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(54) **Capacitive tire sensor and method of assembly**

Kapazitiver Reifensensor und Verfahren zu dessen Montage

Capteur capacitif pour pneumatique et méthode de montage

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US-A1- 2003 056 579

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Description

Field of the Invention

[0001] The present invention relates to stress sensors for measuring stress forces within a material like a rubber compound and, more specifically, to a stress sensor and method of assembly for measuring stress forces present within a rubber compound of a tire.

Background of the Invention

[0002] Capacitor sensors for measuring stress forces within materials are generally well known. Such sensors comprise metallic plates typically formed of a suitable material such as brass. The metallic plates are spaced apart by an air gap and are retained at a predisposed relationship. The metallic plates deflect responsive to stress force within a material and the air gap between the plates varies accordingly. As the air gap varies, the capacitance between the capacitor plates also varies. A signal is directed into the device from a remote source and the capacitance between the metallic sheets is detected by a remote antenna and reader to measure the level of stress force within the material.

[0003] While such capacitor sensors work well and have been well accepted in the industry, several shortcomings in their manufacture and use remain. Existing capacitor stress sensors are relatively complicated to manufacture and assemble, resulting in a greater than optimal cost to the end user. In addition, existing sensors are prone to misalignment resulting in measurement inaccuracy. Still further, existing sensors tend to be susceptible to horizontal and vertical slippage between the capacitor plates when vulcanized into rubber compounds such as a tire. Such slippage distorts the configuration of the sensor and may dislocate the sensor from its optimal, intended location within the material, resulting in a potential for measurement error.

[0004] US-A- 4,168,518 or US-A- 4,458,292 disclose a sensor according to the preamble of claim 1.

Summary of the Invention

[0005] According to one aspect of the invention, a sensor for measuring stress forces within a material such as a tire compound is assembled to include first and second capacitor plates spaced apart by a variably dimensioned air gap. A connector block formed unitarily from a thermoplastic material such as Nylon is situated between the capacitor plates and holds the capacitor plates together in a predetermined mutual orientation. The connector block includes a plurality of rod members protruding from opposite connector block sides and extending into a respective capacitor plate to attach peripheral portions of each capacitor plate to the connector block. The peripheral portions of the capacitor plates may be stepped to accommodate assembly to the connector block. Also, a spacer member is situated between the capacitor plates, the spacer member including opposite spacer member sides held against a respective inward facing surface of the capacitor plates along peripheral portions of the air gap whereby the air gap is calibrated along the peripheral portions to the thickness of the spacer member.

[0006] The spacer member may be formed from a plastic resin such as MYLAR in order to maintain a tight thickness tolerance whereby the air gap spacing between the capacitor plates can be controlled to a desired precision.

[0007] Pursuant to a further aspect of the invention, the connector block rod members may be formed to extend axially through the capacitor plates to an outer plate side and include terminal rod portions formed at an angle over the capacitor plate along the capacitor plate outer side. The terminal ends of the rods thus serve to hold the sensor assembly together and further act to resist any sensor misalignment from horizontal or vertical slippage as the sensor is vulcanized into a tire rubber compound.

[0008] A further aspect of the invention includes a method of assembling the sensor according to claim 7. This method may further include the steps: forming the connector block of heat deformable plastics material; extending the terminal portions of the connector rod members a distance beyond the outer side of a respective capacitor plate; applying heat to the terminal portions of the connector rod members while deforming the terminal portions over the outer side of the respective capacitor plate positioning a spacer member between the capacitor plates with opposite spacer member sides against an inward facing surface of the capacitor plates along peripheral portions of the air gap; and calibrating the air gap along the peripheral portions to the thickness of the spacer member.

[0009] In yet another aspect of the invention, the method may include the steps of forming the external peripheral shapes of the connector block and the capacitor plates to be complementary in external geometric configuration and dimension.

Brief Description of the Drawings

[0010] The invention will be described by way of example and with reference to the accompanying drawings in which:

FIG. 1 is an exploded perspective view of the subject sensor;
FIG. 2 is a top plan view thereof;
FIG. 3 is a transverse sectional view thereof taken along the line 2-2 of FIG. 2;
FIG. 4 is a top perspective view of a partially assembled sensor shown prior to the step of deforming rod member ends downward; and
FIG. 5 is a top perspective view of the finished assembled sensor.

Detailed Description of the Preferred Embodiments

[0011] Referring initially to FIGS. 1-3, the subject sensor 10 is of a general type commonly referred to as capacitor sensors. For example, the sensors may be embedded in a material and used to monitor stress forces acting within the material. A particular application in which such sensors find utility is in the measurement of stresses within a tire rubber compound. One or more of the sensors may be incorporated into the rubber compound of a tire prior to tire vulcanization. The sensors monitor the tire and provide data that may be used to analyze the stress profile of the tire during its manufacture and use.

[0012] Because the process of vulcanization imparts stresses on the sensor within a tire, sensors in such applications have been known to experience horizontal or vertical slippage during the vulcanization process. Such consequences are undesirable and can result in sensor failure or defects in sensor readings.

[0013] With regard to FIGS. 1-3, the sensor 10 will be seen to comprise first and second capacitor plates 12, 14 having a connector block 16 generally disposed therebetween. The plates 12, 14 are of metallic composition and may be fabricated from various known metals or metal alloys such as brass. Metal wires (not shown) having copper or brass surfaces may be soldered to the plates 12, 14 in conventional manner. The plates 12, 14 are shown in a preferred form to be substantially circular, however, other shapes and configurations may be employed if so desired.

[0014] The connector block 16 is preferably formed as a unitary body and composed of heat deformable plastics material. Preferably, it is formed of an electrically insulating material such as nylon. The block 16 may be efficiently made by means of conventional processes such as injection molding. In the preferred form, block 16 is circular and has a general external geometry and dimension that complements the configuration of plates 12, 14. Shapes other than circular may be employed if desired, however. Preferably, the connector block 16 is disposed between peripheral portions 22 of the capacitor plates 12, 14 and extends into the peripheral capacitor plate portions 22 to attach the peripheral plate portions to the connector block 16.

[0015] A spacer ring 18 is also provided for incorporation into the assembly 10 and is preferably situated between the capacitor plates concentrically inward of the connector block. The spacer ring 18 is formed of any suitable material such as plastic by conventional means such as injection molding, or cut out from a film having the desired gauge. One suitable preferred material for ring 18 is MYLAR. As shown, each plate 12, 14 is of similar configuration, having a planar outward facing surface 20 and a peripheral edge portion designated generally at 22. The peripheral plate portion 22 includes an inward facing peripheral surface 24 that extends inwardly to an elevated central surface 26 by means of step 28. A plurality of through-holes 30 is disposed within and preferably at equidistant spacing about peripheral plate portion 22. The number and location of through-holes may be varied from that illustrated if desired.

[0016] Continuing with reference to FIGS. 1-3, as discussed previously, the connector block 16 preferably comprises a unitarily formed ring-shaped body 32 formed from a thermoplastic material such as nylon. The ring-shaped body 32 includes oppositely facing sides 34, 36 and is dimensioned having generally the same radius of curvature as plates 12, 14. A central aperture 38 is disposed within body 32 and a plurality of connector rod members 40 extend from the sides 34, 36 at a spacing complementary with the spacing of apertures 30 through plates 12, 14. The rod members 40 are elongate and preferably straight and symmetrical about a longitudinal axis. Integral to each rod member 40 is a remote terminal end portion 42.

[0017] The spacer ring 18 includes a preferably unitary spacer body 44 composed of any suitable material such as plastic resin. MYLAR is one such acceptable material. The ring 18 has a radius of curvature smaller than that of the connector block 16 and plates 12, 14. While preferred, the circular configuration of blocks 16, 18 and plates 12, 14 may be varied without departing from the invention. The spacer body 44 is dimensioned to fit over and closely encircle the raised central surface 26 of each plate adjacent each plate's step 28.

[0018] Assembly of the subject sensor 10 proceeds as follows. The individual components 12, 14, 16, and 18 are fabricated as described above. The connector block 16 is disposed between the capacitor plates 12, 14. The two brass sheets or plates 12, 14 attach to the opposite sides 34, 36 of connector block 16 as the through-holes 30 of plates 12, 14 are slipped over the connector rod members 40. Through-holes 30 are dimensioned and spaced for close receipt of the rod members 40 therethrough. As the plates 12, 14 are brought against the connector block 16, the spacer ring 18 is sandwiched between the elevated central surfaces 26 of plates and encircles the perimeter of plate surfaces 26.

[0019] As will be appreciated from the sectional view of FIG. 3, the stepped inner profile of the capacitor plates 12, 14 compliments the external shape and dimension of the connector block 16 such that an air gap 48 is defined between plate central surfaces 26 of plates 12, 14 as the plates are brought into final abutment against the connector block. The brass plates 12, 14 are designed in section to have a two-step profile such that when brought together against connector block 16, air gap 48 results. The air gap 48 is generally rectangular in profile and extends across the central opening 38 of the connector block 16. Manufacturing the components 12, 14, and 16 to close tolerances ensures that the air gap 48 will be defined to a desired width. A nominal reference capacitance between plates 12, 14 can thus be established.

[0020] The small air gap 48, preferentially in the range of 1-50 micrometers, is further controlled by the presence of spacer ring 18.

[0021] The presence of spacer ring 18 allows for greater control over the width of the gap. Spacer ring is preferentially formed of a hard plastic such as MYLAR and may be formed to tight dimensional tolerances by conventional molding techniques such as injection molding, blown film or calendered film. Location of the ring 18 around peripheral portions of the air gap 48 in abutment with surfaces 26 of plates 12, 14, ensures that the peripheral portions of air gap 48 will be calibrated to the thickness of the spacer ring 18.

[0022] FIG. 4 illustrates the sensor at a partially assembled state with plates 12, 14 positioned against opposite sides of connector block 16 and rod members 40 extending through the plates 12, 14. Thereafter, the terminal portions 42 of rods 40 are melted by the application of heated die (not shown) to extend along the top surface 20 of each plate at substantially a right angle. The angle of deformation of rod portions 42, while preferentially ninety degrees, may be varied if desired. Once cooled, the deformed portions 42 of rods 40 fixes the brass plates 12, 14 into their intended mutual position against the connector block 16 and avoids any horizontal or vertical slippage of the plates relative to the connector block that might otherwise occur. The avoidance of slippage is particularly important should the sensor be subsequently vulcanized into a tire rubber compound.

[0023] One or more of the completed sensor assemblies as shown in FIG. 5 may be incorporated into a material monitor stress forces within the material. The composition of plates 12, 14 is selected so that metal wires (not shown) may be attached to the plate outer surfaces 20 by soldering or other known techniques. The device 10 may thus be connected to other mechanical devices or electronic circuitry (not shown) of conventional form. Alternatively, a signal may be induced into the sensor plates 12, 14. An antenna (not shown) may be positioned to pick up variations to the induced signal resulting from capacitance changes in the device.

[0024] Located within a rubber compound, the air gap 48 will vary in thickness as plates 12, 14 flex inward under the influence of stress forces. The capacitance of device 10 will accordingly change in proportion to the applied stress force. The change in capacitance may be monitored by associate circuits connected to device 10 and the level of stress within the material deduced from changes in capacitance levels.

[0025] From the foregoing, it will be appreciated that the subject invention satisfies the needs of the industry for a stress sensor that is readily and economically fabricated, assembled and deployed. The sensor 10 may be made in various shapes including the circular form shown in the preferred embodiment. The deformation of rods 40 is an economical means to attach the sensor components together and to maintain their preferred mutual orientation against vertical and horizontal slippage. The use of a heat deformable material in the construction of connector block 16 facilitates the bending of rod portions 42.

Claims

1. A sensor (10) for detecting stress within a material comprising first and second capacitor plates (12, 14) spaced apart by an air gap (48), wherein a connector block (16) is situated between the capacitor plates (12, 14) and holds the capacitor plates (12, 14) together in a predetermined mutual orientation, the connector block (16) including a plurality of rod members (40) protruding from opposite connector block sides (34, 36) and extending into a respective capacitor plate (12, 14) to attach peripheral portions (22) of each capacitor plate (12, 14) to the connector block (16), **characterized in that** the sensor further comprises a spacer member (18) situated between the capacitor plates (12, 14), the spacer member (18) including opposite spacer member sides held against a respective inward facing surface (24) of the capacitor plates (12, 14) along peripheral portions of the air gap (48) whereby the air gap (48) is variably dimensioned and calibrated along the peripheral portions to the thickness of the spacer member (18).

2. The sensor according to claim 1, wherein the connector block rod members (40) extend axially through the capacitor plates (12, 14) to an outer plate side and include terminal rod portions (42) formed at an angle over the capacitor plate (12, 14) along the capacitor plate outer side.

3. The sensor according to claim 2, wherein each respective terminal rod portion (42) of a rod member (40) extends at approximately a ninety degree angle to a longitudinal axis of the rod member (40).

4. The sensor according to at least one of the previous claims, wherein the connector block rod members (40) are composed of a heat deformable plastics material.

5. A tire and sensor assembly for detecting stress within a tire rubber material, **characterized by** a tire having a target region at least partially composed of rubber; and a sensor (10) according to at least one of claims 1-4.

6. The assembly as set forth in claim 5, wherein the connector block rod members (40) extend axially through the capacitor plates (12, 14) to an outer plate side and include terminal rod portions (42) formed to extend over the capacitor plate (12, 14) along the capacitor plate outer side and wherein the terminal rod portion (42) of a rod member (40) preferably ex-

tends at approximately a ninety-degree angle to a longitudinal axis of the rod member (40).

7. A method of assembly for a sensor (10) for detecting stress within a material, the sensor (10) comprising first and second capacitor plates (12, 14), the method comprising the steps of:

a) forming a plurality of through-holes through peripheral portions (22) of each capacitor plate (12, 14);
b) positioning a connector block (16) between the capacitor plates (12, 14);
c) extending a plurality of rod members (40) through respective through-holes (30) in the capacitor plates (12, 14) to attach the peripheral portions (22) of each capacitor plate (12, 14) to the connector block (16); and
d) forming terminal rod portions (42) of the rod members (40) over an outer side of a respective capacitor plate (12, 14);

characterized in that
the connector block (16) positioned between the capacitor plates (12, 14) includes the plurality of rod members (40) protruding from opposite connector block sides; and
the method further comprises spacing the first and second capacitor plates (12, 14) apart by a variably dimensioned air gap (48) by positioning a spacer member (18) between the capacitor plates (12, 14) with opposite spacer member sides against an inward facing surface (24) of the capacitor plates (12, 14) along peripheral portions of the air gap (48); and calibrating the air gap (48) along the peripheral portions to the thickness of the spacer member (18).

8. The method of assembly as set forth in claim 7, further comprising the steps of:

forming the connector block (16) of heat deformable plastics material;
extending the terminal portions (42) of the connector rod members (40) a distance beyond the outer side of a respective capacitor plate (12, 14); and
applying heat to the terminal portions (42) of the connector rod members (40) while deforming the terminal portions (42) over the outer side of the respective capacitor plate (12, 14).

Patentansprüche

1. Sensor (10) zum Erfassen von Spannung in einem Material, der eine erste und eine zweite kapazitive Platte (12, 14), die durch einen Luftspalt (48) voneinander beabstandet sind, umfasst, wobei ein Anschlussblock (16) sich zwischen den kapazitiven Platten (12, 14) befindet und die kapazitiven Platten (12, 14) in einer vorbestimmten gegenseitigen Orientierung zusammenhält, wobei der Anschlussblock (16) eine Vielzahl von Stabelementen (40) beinhaltet, die von entgegengesetzten Anschlussblockseiten (34, 36) vorragen und sich in eine jeweilige kapazitive Platte (12, 14) erstrecken, um periphere Teile (22) jeder kapazitiven Platte (12, 14) an dem Anschlussblock (16) zu befestigen, **dadurch gekennzeichnet, dass** der Sensor weiter ein zwischen den kapazitiven Platten (12, 14) befindliches Abstandhalterelement (18) umfasst, wobei das Abstandhalterelement (18) entgegengesetzte Abstandhalterelementseiten umfasst, die entlang peripheren Teilen des Luftspalts (48) gegen eine jeweilige einwärts gewandte Fläche (24) der kapazitiven Platten (12, 14) gehalten werden, wodurch der Luftspalt (48) variabel dimensioniert und entlang der peripheren Teile auf die Dicke des Abstandhalterelements (18) justiert ist.

2. Sensor gemäß Anspruch 1, wobei die Anschlussblock-Stabelemente (40) sich axial durch die kapazitiven Platten (12, 14) zu einer äußeren Plattenseite erstrecken und in einem Winkel über der kapazitiven Platte (12, 14) entlang der Außenseite der kapazitiven Platte geformte Stabendteile (42) beinhalten.

3. Sensor gemäß Anspruch 2, wobei jedes jeweilige Stabendteil (42) eines Stabelements (40) sich in einem Winkel von etwa neunzig Grad zu einer Längsachse des Stabelements (40) erstreckt.

4. Sensor gemäß mindestens einem der vorhergehenden Ansprüche, wobei die Anschlussblock-Stabelemente (40) aus einem hitzeverformbaren Kunststoffmaterial zusammengesetzt sind.

5. Reifen- und Sensorbaugruppe zur Erfassung von Spannung in einem Reifenkautschukmaterial, **gekennzeichnet durch** einen Reifen mit einem zumindest teilweise aus Kautschuk zusammengesetzten Zielbereich; und einen Sensor (10) gemäß mindestens einem der Ansprüche 1-4.

6. Baugruppe, wie in Anspruch 5 ausgeführt, wobei die Anschlussblock-Stabelemente (40) sich axial durch die kapazitiven Platten (12, 14) zu einer äußeren Plattenseite erstrecken und Stabendteile (42) beinhalten, die dazu geformt sind, sich über die kapazitive Platte (12, 14) entlang der Außenseite der kapazitiven Platte zu erstrecken, und wobei der Stabendteil (42) eines Stabelements (40) sich bevorzugt in einem Winkel von etwa neunzig Grad zu einer Längsachse des Stabelements (40) erstreckt.

7. Montageverfahren für einen Sensor (10) zur Erfassung von Spannung in einem Material, wobei der Sensor (10) eine erste und eine zweite kapazitive Platte (12, 14) umfasst, wobei das Verfahren die Schritte umfasst des:

a) Formens einer Vielzahl durchgehender Öffnungen durch periphere Teile (22) jeder kapazitiven Platte (12, 14);
b) Positionierens eines Anschlussblocks (16) zwischen den kapazitiven Platten (12, 14);
c) Erstreckens einer Vielzahl von Stabelementen (40) durch jeweilige durchgehende Öffnungen (30) in den kapazitiven Platten (12, 14), um die peripheren Teile (22) jeder kapazitiven Platte (12, 14) an dem Anschlussblock (16) zu befestigen; und
d) Formens von Stabendteilen (42) der Stabelemente (40) über eine Außenseite einer jeweiligen kapazitiven Platte (12, 14);

dadurch gekennzeichnet, dass
der zwischen den kapazitiven Platten (12, 14) positionierte Anschlussblock (16) die von entgegengesetzten Anschlussblockseiten vorragende Vielzahl von Stabelementen (40) beinhaltet; und
das Verfahren weiter das voneinander Beabstanden der ersten und zweiten kapazitiven Platte (12, 14) durch einen variabel dimensionierten Luftspalt (48) durch Positionieren eines Abstandhalterelements (18) zwischen den kapazitiven Platten (12, 14), mit entgegengesetzten Abstandhalterelementseiten gegen eine einwärts gewandte Fläche (24) der kapazitiven Platten (12, 14) entlang peripherer Teile des Luftspalts (48); und Justieren des Luftspalts (48) entlang der peripheren Teile auf die Dicke des Abstandhalterelements (18) umfasst.

8. Montageverfahren, wie in Anspruch 7 ausgeführt, weiter die Schritte umfassend des:

Formens des Anschlussblocks (16) aus hitzeverformbarem Kunststoffmaterial;
Erstreckens der Endteile (42) der Anschlussstabelemente (40) über einen Abstand über die Außenseite einer jeweiligen kapazitiven Platte (12, 14) hinaus; und
Anlegens von Hitze an die Endteile (42) der Anschlussstabelemente (40), während die Endteile (42) über die Außenseite der jeweiligen kapazitiven Platte (12, 14) verformt werden.

Revendications

1. Capteur (10) pour détecter des contraintes au sein d'une matière, comprenant une première et une deuxième plaque de condensateur (12, 14) maintenues à l'écart l'une de l'autre par un entrefer (48), un bloc de connexion (16) étant disposé entre les plaques de condensateur (12, 14) et maintenant ensemble les plaques de condensateur (12, 14) dans des orientations réciproques prédéterminées, le bloc de connexion (16) englobant plusieurs membres en forme de tige (40) faisant saillie par rapport aux côtés opposés du bloc de connexion (34, 36) et s'étendant jusque dans une plaque de condensateur respective (12, 14) pour fixer des portions périphériques (22) de chaque plaque de condensateur (12, 14) au bloc de connexion (16), **caractérisé en ce que** le capteur comprend en outre un membre faisant office d'élément d'espacement (18) et situé entre les plaques de condensateur (12, 14), le membre (18) faisant office d'élément d'espacement englobant des côtés opposés du membre faisant office d'élément d'espacement maintenus contre une surface respective (24) orientée vers l'intérieur des plaques de condensateur (12, 14) le long des portions périphériques de l'entrefer (48), l'entrefer (48) étant dimensionné de manière variable et étant étalonné le long des portions périphériques par rapport à l'épaisseur du membre faisant office d'élément d'espacement (18).

2. Capteur selon la revendication 1, dans lequel les membres (40) en forme de tige du bloc de connexion s'étendant en direction axiale à travers les plaques de condensateur (12, 14) en direction du côté externe des plaques englobent des portions de tiges terminales (42) formant un angle par-dessus les plaques de condensateur (12, 14) le long du côté externe des plaques de condensateur.

3. Capteur selon la revendication 2, dans lequel chaque portion de tige terminale respective (42) d'un membre (40) en forme de tige s'étend en formant un angle approximatif de 90° par rapport à l'axe longitudinal du membre (40) en forme de tige.

4. Capteur selon l'une quelconque des revendications précédentes, dans lequel les membres en forme de tige (40) du bloc de connexion sont composés d'une matière plastique thermodéformable.

5. Assemblage d'un bandage pneumatique et d'un capteur pour détecter des contraintes au sein d'une matière de caoutchouc pour bandage pneumatique, **caractérisé par** un bandage pneumatique possédant une zone cible composée au moins en partie de caoutchouc et un capteur (10) selon au moins une des revendications 1 à 4.

6. Assemblage selon la revendication 5, dans lequel les membres (40) en forme de tige du bloc de connexion s'étendent en direction axiale à travers les plaques de condensateur (12, 14) jusqu'au côté externe des plaques et englobent des portions de tiges terminales (42) formées pour s'étendre par-dessus les plaques de condensateur (12, 14) le long du côté externe des plaques de condensateur, et dans lequel la portion de tige terminale (42) d'un membre en forme de tige (40) s'étend de préférence en formant un angle approximatif de 90° par rapport à l'axe longitudinal du membre (40) en forme de tige.

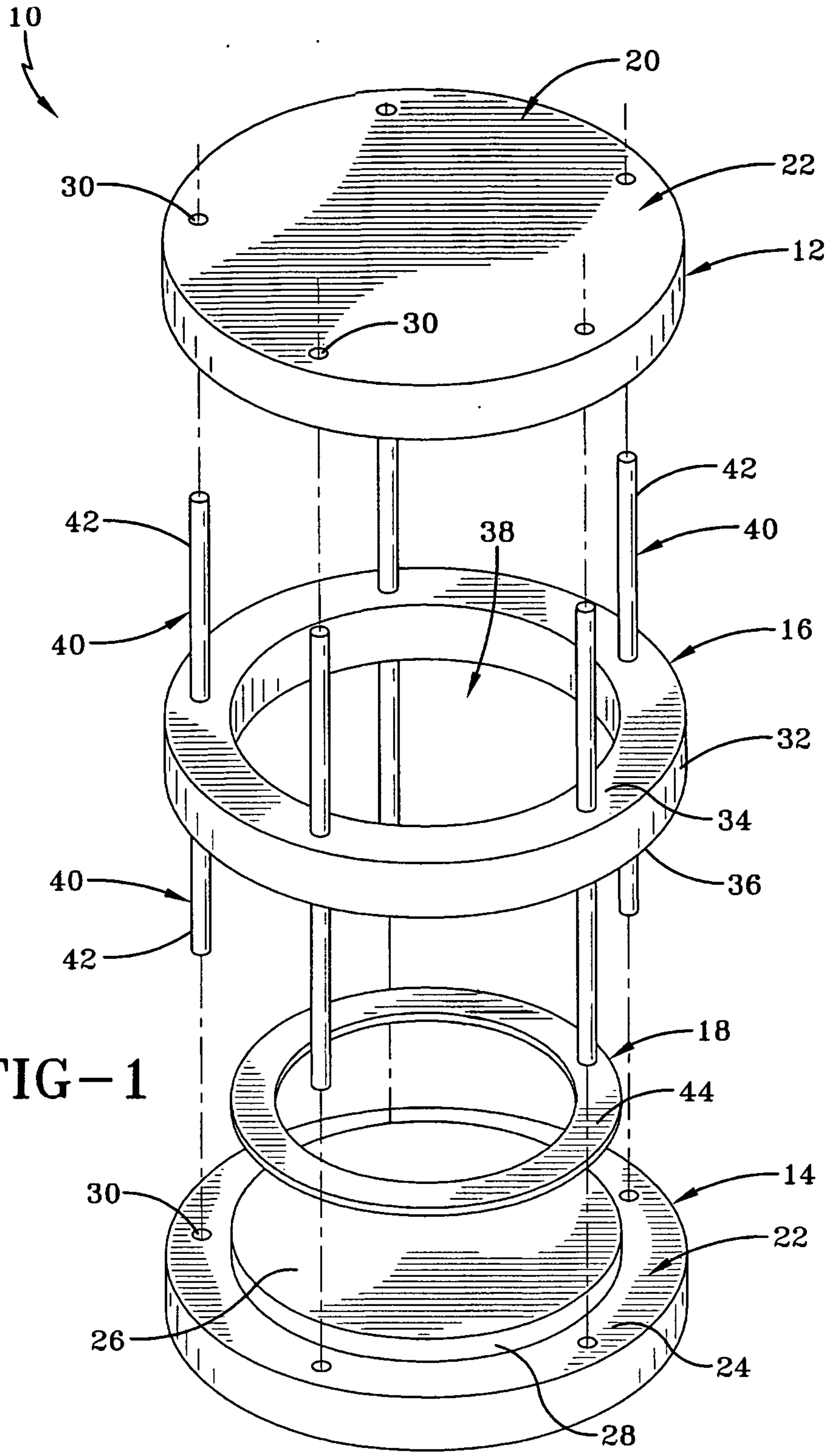
7. Procédé d'assemblage d'un capteur (10) pour détecter des contraintes au sein d'une matière, le capteur (10) comprenant une première et une deuxième plaque de condensateur (12, 14), le procédé comprenant les étapes consistant à :

a) former plusieurs trous de passage à travers des portions périphériques (22) de chaque plaque de condensateur (12, 14) ;
b) disposer un bloc de connexion (16) entre les plaques de condensateur (12, 14) ;
c) étendre plusieurs membres (40) en forme de tige à travers des trous de passage respectifs (30) dans les plaques de condensateur (12, 14) pour fixer les portions périphériques (22) de chaque plaque de condensateur (12, 14) au bloc de connexion (16) ; et
d) former des portions de tiges terminales (42) des membres (40) en forme de tige par-dessus le côté externe d'une plaque de condensateur respective (12, 14) ;

caractérisé en ce que
le bloc de connexion (16) disposé entre les plaques de condensateur (12, 14) englobe lesdits plusieurs membres (40) en forme de tige faisant saillie par rapport aux côtés opposés du bloc de connexion ; et le procédé comprend en outre le fait d'écarter, l'une de l'autre, la première et la deuxième plaque de condensateur (12, 14) via un entrefer (48) de dimension variable en positionnant un membre (18) faisant office d'élément d'espacement entre les plaques de condensateur (12, 14), les côtés opposés du membre faisant office d'élément d'espacement venant se disposer contre une surface (24) orientée vers l'intérieur, des plaques de condensateur (12, 14) le long des portions périphériques de l'entrefer (48), et le fait d'étalonner l'entrefer (48) le long des portions périphériques par rapport à l'épaisseur du membre (18) faisant office d'élément d'espacement.

8. Procédé d'assemblage selon la revendication 7, comprenant en outre les étapes consistant à :

réaliser le bloc de connexion (16) à partir d'une matière plastique thermodéformable ;
étendre les portions terminales (42) des membres (40) faisant office de tige de raccordement sur une distance s'étendant au-delà du côté externe d'une plaque de condensateur respective (12, 14) et
appliquer de la chaleur sur les portions terminales (42) des membres (40) faisant office de tige de raccordement, tout en déformant les portions terminales (42) par-dessus le côté externe de la plaque de condensateur respective (12, 14).


10
20
22
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12
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42
42
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16
32
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42
18
44
30
14
22
26
24
28

FIG-1

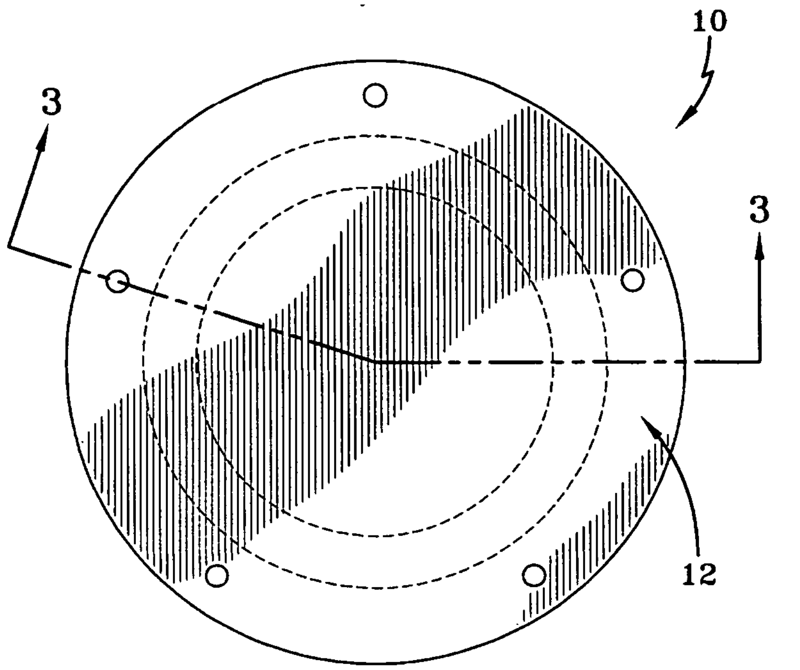

FIG-2

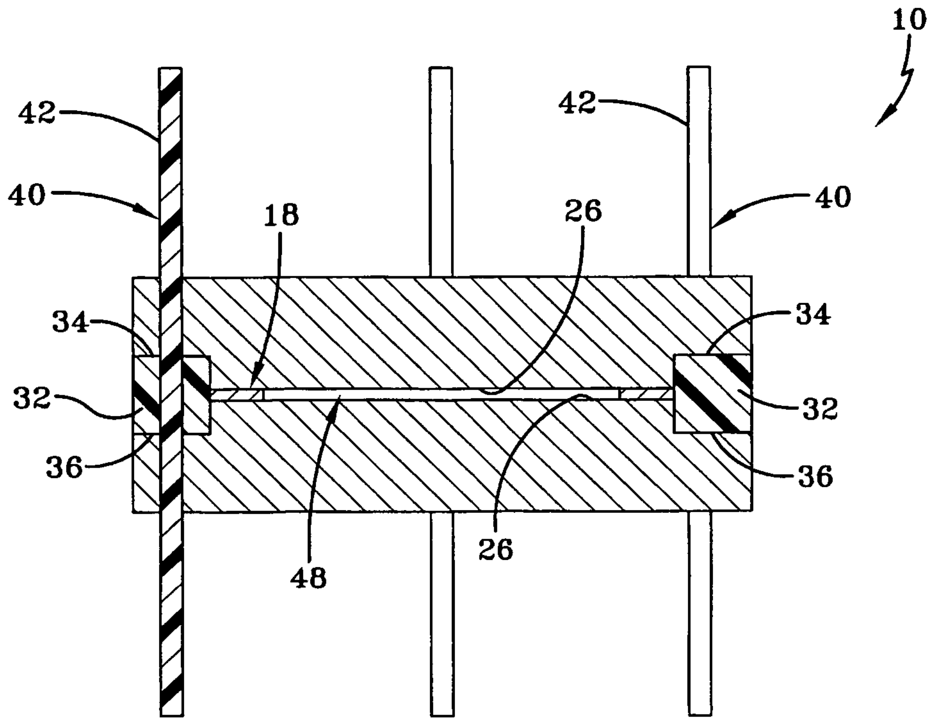

FIG-3

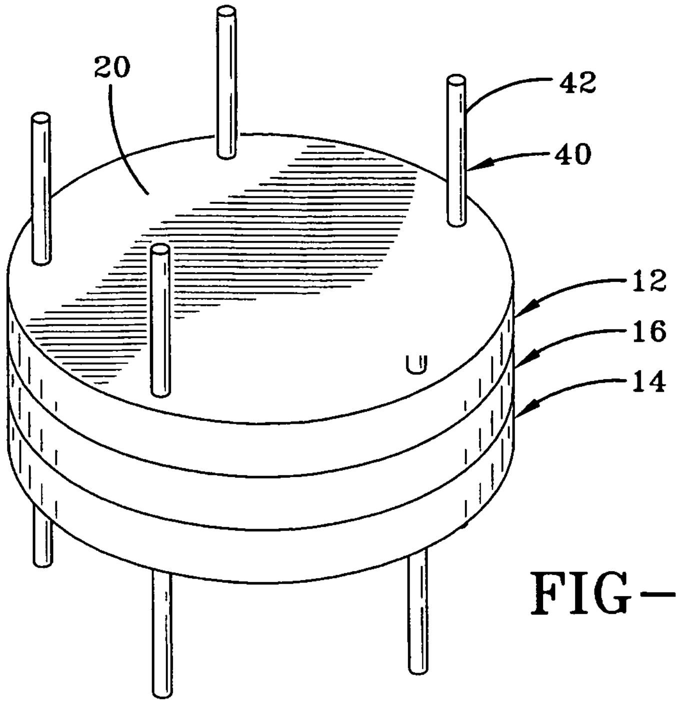

FIG-4

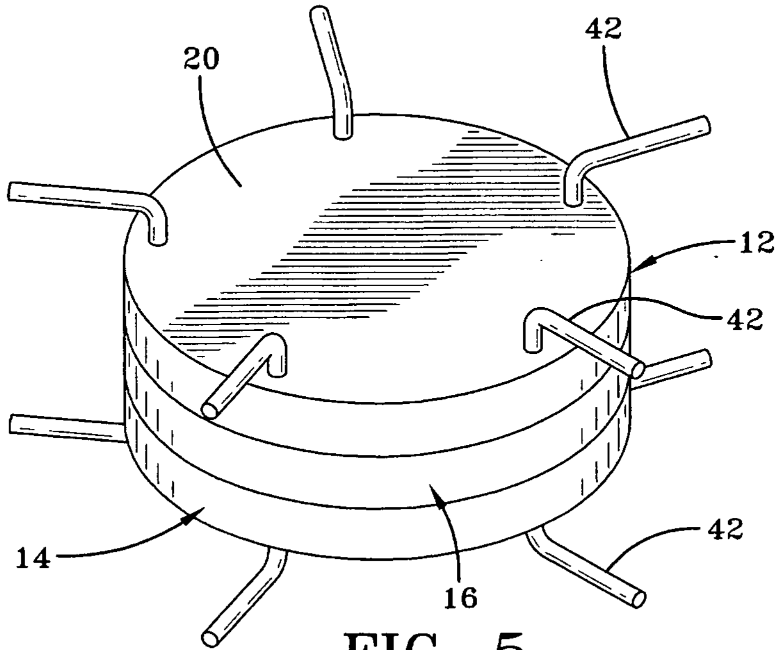

FIG-5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4168518 A **[0004]**
- US 4458292 A **[0004]**